

# Effect of Otago Exercise Programme in Chronic Knee Osteoarthritis after Platelet-Rich Plasma Injection: A Case Series

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## ABSTRACT

**Background:** Knee osteoarthritis (OA) is an insidious process that may eventually cause disability of the joint, pain, loss of balance, and a poor quality of life. PRP injection is efficacious in managing the symptoms of knee OA; however, further rehabilitation after PRP therapy showed greater functional benefits. The Otago Exercise Program (OEP), which includes balance and muscle-strengthening exercises, shows another benefit for knee OA patients. To investigate the effects of the Otago Exercise Programme after PRP injection in individuals with chronic knee osteoarthritis.

**Methods:** Grade II and III knee OA cases who had previously received PRP injections before participation in this study. All the participants underwent a four-week Otago exercise programme that included warm-up, strengthening, and balance exercises. Outcome measures, including the Numeric Pain Rating Scale (NPRS), the Berg Balance Scale (BBS), the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and the Falls Efficacy Scale-International (FES-I), were measured at baseline and at the second and fourth weeks of exercise.

**Results:** Four patients (mean age  $54.50 \pm 7.85$  years) were assessed using NPRS, BBS, WOMAC, and FES-I following the Otago Exercise Programme after PRP injection. The findings demonstrated a reduction in NPRS, with improvements in BBS, WOMAC, and FES-I scores at the end of four weeks of intervention. Overall, all participants demonstrated improvement in pain, balance, functional performance, and fear of falling following the intervention.

**Conclusion:** Based on the results of the current case series, it can be suggested that the Otago exercise program following PRP injection helps reduce pain, improve balance and mobility, and decrease fear of falling among people with chronic knee osteoarthritis. It might be helpful to combine biological and rehabilitation approaches for managing chronic knee OA.

**Keywords:** Knee Osteoarthritis, Platelet-Rich Plasma, Pain, Exercise therapy, Fear, Fall.

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## INTRODUCTION

Knee osteoarthritis is one of the most common musculoskeletal conditions across the world, which afflicts over 500 million people and is considered a major source of chronic pain, disability, and poor health status, especially among elderly patients. The disease entails gradual degeneration of joint cartilage, synovitis, bone remodelling beneath the cartilage, and muscle weakness. <sup>(1)</sup> Its multifactorial aetiology, encompassing advancing age, obesity, biomechanical overload, and

genetic predisposition, necessitates a multimodal management strategy integrating pharmacological, biological, and rehabilitative modalities. <sup>(2)</sup>

Intra-Articular PRP Injection is a biological treatment that has become increasingly popular for treating of knee osteoarthritis. In addition to being an autologous platelet concentrate containing various growth factors such as TGF- $\beta$ , PDGF, VEGF, and IGF, intra-articular PRP injection has a chondroprotective and anti-inflammatory effect. <sup>(3)</sup> Several review studies have found that PRP offers better analgesia and function improvement as

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opposed to treatments such as HA and corticosteroids in early-moderate disease states. <sup>(4)</sup> Nevertheless, there could be an additional benefit of combining PRP treatment with physical rehabilitation because exercising after injections enhances the distribution of growth factors and increases the nutrition of the cartilage. <sup>(5)</sup> The Otago Exercise Programme (OEP), initially designed to reduce falls among elderly people, consists of progressively challenging lower-body strengthening and balance exercises. The programme is effective in enhancing muscle strength, balance, and walking among elderly people living in their communities. <sup>(6)</sup> Given that knee OA patients commonly exhibit quadriceps weakness, proprioceptive deficits, and elevated fall risk, the OEP represents a clinically relevant and cost-effective rehabilitative adjunct for this population. <sup>(7)</sup> Despite the individual merits of both PRP and the OEP, no study to date has examined their combined application in chronic knee OA. Thus, this case series is designed to evaluate the clinical effectiveness of the Otago Exercise Programme initiated after intra-articular PRP administration in patients with knee osteoarthritis (OA). The results are expected to provide initial data on integrative rehabilitation approaches and to generate hypotheses for future research.

### Case Description:

This case series reports on four patients diagnosed with chronic knee osteoarthritis (OA) who attended the Physiotherapy Outpatient Department at a tertiary hospital after receiving Platelet-Rich Plasma (PRP) injections. Diagnosis was confirmed using clinical examination and Kellgren-Lawrence grading. The study included three females and one male with a mean age of  $54.50 \pm 7.85$  years. All participants presented with chronic knee pain, impaired balance, reduced mobility, functional limitations, and fear of falling associated with Grade II or III knee OA.

All patients underwent a detailed clinical assessment before intervention. Outcome measures included the Numeric Pain Rating Scale (NPRS), Berg Balance Scale (BBS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and Falls Efficacy Scale-International (FES-I). Most participants were overweight and experienced difficulty during prolonged standing, walking, stair climbing, and daily functional activities.

CASE 1: The patient is a 51-year-old female school teacher who reported experiencing symptoms of chronic bilateral knee osteoarthritis grade III according to Kellgren-Lawrence classification <sup>(8)</sup> in the form of deep aching bilateral knee pain (NPRS 7/10 in movement, 4/10 when resting), morning stiffness lasting for 30-40 minutes, problems walking down stairs, and knee joint instability while walking; her body mass index was 29.4 kg/m<sup>2</sup>. About three to four weeks before referral to physiotherapy, she underwent three intra-articular leukocyte PRP injections in the right knee and one

injection in the left knee; there were some improvements in terms of pain relief, but the problems with balance and functional disability still remained, hence, she was referred to participate in the 4-week Otago Exercise Programme.

CASE 2: The patient is a 58-year-old man working as a shopkeeper who was diagnosed with bilateral osteoarthritis in his knees, both Grade III (according to Kellgren-Lawrence grade), and had a BMI of 30.7 kg/m<sup>2</sup>. The patient was experiencing pain in both knees, which gets worse when he stands for too long (NPRS 8/10 during activity/5/10 at rest), morning stiffness lasting one hour, inability to stand upright for longer than twenty minutes, and he had received three PRP injections into the right knee and two into the left at six week intervals with some reduction in pain, but not enough improvement in functional ability and dynamic balance to refer him to the Otago Exercise Program for four weeks. The initial assessments indicated severe pain (NPRS 8/10 (activity) / 5/10 (rest)), high risk of falling (Berg Balance Scale 34/56), high level of disability (WOMAC 59/96), and high level of fear of falling (FES-I 43/64).

CASE 3: The patient is a 49-year-old female nurse who suffered from grade II knee osteoarthritis of the right side, with a body mass index of 27.8 kg/m<sup>2</sup>. Her symptoms included moderate to severe pain related to activities (on the activity scale 7/10 on NPRS, 3/10 at rest); morning stiffness lasting 30 minutes; inability to climb stairs repeatedly on duty at the ward; and reduced work hours because of pain and knee instability. She had received two intra-articular PRP injections into her right knee, three weeks apart, within six weeks before physiotherapy referral, with some improvement in pain reduction. However, she still experienced balance problems due to prolonged standing after five months, for which she was referred to the 4-week Otago Exercise Programme. Baseline Results: NPRS 7/10 (activity) / 3/10 (rest); severe activity pain; Berg Balance Scale 40/56, mild-to-moderate fall risk; WOMAC 65/96, moderate disability; FES-I 39/64, moderate fear of falling.

CASE 4: A 44-year-old woman who is a homemaker reported complaints of a two-and-a-half-year history of Grade II left knee osteoarthritis (Kellgren-Lawrence) and a BMI of 33.1 kg/m<sup>2</sup>. She complained of moderate to severe activity-related pain in her knee joint (NPRS 6/10 for activity and 3/10 at rest), swelling of the left knee joint, morning stiffness lasting 25 minutes, and bilateral knee joint buckling while performing domestic activities. The patient was injected with three doses of platelet-rich plasma into her left knee joint every two weeks ten weeks prior to physiotherapy assessment. This resulted in moderate pain relief but continued swelling and gait imbalance leading to enrollment into the Otago Exercise Programme.

**Procedure:** -

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After institutional ethical committee approval and patients informed consent, the demographic data (age, gender, height, weight, BMI) and baseline data were taken. Otago Exercise Program- The program consist of Warm up exercise, strength training, balance and mobility exercises that was delivered for 4 weeks.<sup>(9)</sup> The outcomes were again recorded after 4 weeks.

Outcomes: -

**Numeric pain rating scale (NPRS):** It is a self-reported outcome used to assess pain intensity on scale from 0 to 10, where 0 indicates no pain, and 10 indicates the worst pain. It's a reliable and valid tool to assess pain intensity in patients with knee OA. It demonstrates high test-retest reliability and good construct validity ICC=0.95).<sup>(10)</sup>

**Berg Balance Scale (BBS):** It is a 14-item performance-based scale used to evaluate static and dynamic balance abilities in functional activities. Score range 0 to 56, with a lower score indicating greater balance impairment and increased fall risk. The scale demonstrates excellent reliability and validity in individuals with knee OA and is widely used to assess balance performance.<sup>(11)</sup>

**Western Ontario and McMaster Universities Osteoarthritis Index(WOMAC):** is a disease-specific questionnaire designed to assess pain, stiffness, and physical function in patients with knee and hip OA. A higher WOMAC score indicates worse pain, stiffness, and functional limitation. It has excellent internal consistency (Cronbach's alpha 0.80) and high test-retest reliability (ICC=0.77 to 0.96).<sup>(12)</sup>

**Falls Efficacy Scale-International (FES-I):** It is a questionnaire used to assess concern or fear of falls during activities. Score range: low concern to great concern. A higher score indicates greater fear of falling and reduced confidence during movement-related tasks. The FES-I scale demonstrates excellent reliability and validity with reported test-retest reliability of ICC=0.96 and high internal consistency(alpha=0.96).<sup>(13)</sup>

### Case descriptive analysis:

Case no	Age in years	Diagnosis	Injured side	BMI	Duration of symptoms	Physical activity
1	51	Grade 3 knee OA	Bilateral	29.4	2 years	No
2	58	Grade 3 knee OA	Bilateral	30.7	3 years	No
3	49	Grade 2 knee OA	Right >left	27.8	6 months	No
4	44	Grade 2 knee OA	Left	33.1	2.5 years	No

Variable	Case 1	Case 2	Case 3	Case 4
<b>NPRS</b>				
Baseline	7	7	8	7
At 2 <sup>nd</sup> week	5	6	6	6
At 4 <sup>th</sup> week	3	4	3	2
<b>Berg Balance scale</b>				
Baseline	28	35	36	38
At 2 <sup>nd</sup> week	35	44	43	45
At 4 <sup>th</sup> week	44	46	51	50
<b>WOMAC</b>				
Baseline	38	35	41	34
At 2 <sup>nd</sup> week	29	28	35	26
At 4 <sup>th</sup> week	21	22	27	19
<b>FES-I</b>				
Baseline	48	39	50	46
At 2 <sup>nd</sup> week	40	32	44	39
At 4 <sup>th</sup> week	34	26	37	33

Discussion: -

The present case series explored the combined effect of the Otago Exercise Programme (OEP) following Platelet-Rich Plasma (PRP) injection in individuals with chronic knee osteoarthritis (OA). The findings demonstrated clinically meaningful improvements in pain intensity, functional disability, balance performance, and fear of falling after four weeks of intervention. The present case series showed a consistent trend of improvement across all participants suggests that integrating structured exercise rehabilitation after PRP may provide additional benefits beyond biological injection therapy alone.

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One of the most notable findings of the present study was the significant reduction in pain intensity measured using the Numeric Pain Rating Scale (NPRS). The Connell study reported positive results with the use of PRP in knee OA<sup>(14)</sup> Kon et al. demonstrated that intra-articular PRP injections reduce pain and improve joint function by modulating inflammatory mediators and promoting cartilage healing.<sup>(15)</sup> Similarly, Migliorini et al.<sup>(16)</sup> reported in a meta-analysis that PRP showed superior outcomes compared with hyaluronic acid and corticosteroid injections in patients with mild-to-moderate knee OA. In the current study, the additional improvement after initiation of OEP may indicate that exercise rehabilitation enhanced neuromuscular adaptation and reduced mechanical stress on the knee joint, thereby augmenting the therapeutic effects of PRP. The improvement in functional disability, as measured by WOMAC, also supports the effectiveness of the combined intervention. Based on results across all participants, the clinical improvement observed was considerable. Exercise-based rehabilitation is widely regarded as a core treatment strategy for knee OA because it improves muscle strength, joint stability, and functional mobility.<sup>(17)</sup> Bennell and Hinman highlighted that strengthening and neuromuscular exercises can significantly improve physical function and reduce disability in knee OA patients.<sup>(18)</sup> The current findings align with this concept, as the progressive strengthening and balance components of OEP likely contributed to improved lower limb control and reduced difficulty during activities such as stair climbing, prolonged standing, and walking.

Another important outcome of this study was the improvement in balance performance assessed through the Berg Balance Scale (BBS). Participants demonstrated progressive increases in BBS scores from baseline to the fourth week, indicating reduced fall risk and improved postural stability. Patients with knee OA commonly exhibit impaired proprioception, quadriceps weakness, altered gait mechanics, and fear of movement, all of which contribute to balance deficits and increased fall risk. The OEP was originally designed to reduce falls in older adults through progressive balance retraining and lower limb strengthening exercises. Previous studies by Yang et al.<sup>(19)</sup> and Xie et al.<sup>(20)</sup> reported that OEP significantly improves balance, gait performance, and functional mobility in elderly individuals. The present study extends these findings to patients with chronic knee OA following PRP treatment, suggesting that OEP may serve as an effective adjunct rehabilitation strategy in this population.

Fear of falling, as assessed by the Falls Efficacy Scale-International (FES-I), also showed meaningful improvement during the intervention period. Mat S et al.<sup>(21)</sup> reported moderate-to-high concern about falling among participants, which substantially reduced. Fear of falling is clinically important in knee OA because it can

lead to reduced physical activity, social withdrawal, and further muscle deconditioning. Improvement in FES-I scores in the present study may be attributed to enhanced confidence during mobility tasks resulting from better balance control and reduced pain levels. Similar findings have been reported in fall-prevention literature, where structured balance exercises improved both physical performance and psychological confidence in movement.

The combined use of PRP and OEP may have synergistic therapeutic effects in the management of chronic knee OA. PRP primarily addresses the biological environment of the osteoarthritic joint through anti-inflammatory and regenerative mechanisms<sup>(22)</sup>, whereas studies showed OEP addresses biomechanical and neuromuscular impairments.<sup>(23)</sup> This multimodal approach provides a more comprehensive management strategy compared with isolated interventions. Cakmak et al.<sup>(24)</sup> suggested that post-injection rehabilitation may enhance the distribution of growth factors within the joint and optimize tissue healing responses. In the current case series, the integration of progressive strengthening, gait retraining, and balance exercises following PRP may have facilitated improved joint loading patterns and functional recovery.

The clinical characteristics of the participants also support the applicability of the intervention in real-world settings. All patients presented with moderate-to-severe symptoms, functional limitations, elevated BMI, and impaired balance, which are common clinical features in chronic knee OA populations. Despite differences in age, sex, and OA severity, all participants demonstrated improvement following the intervention, suggesting that the combined approach may be feasible across diverse patient profiles. Additionally, the home-based and low-cost nature of OEP makes it particularly valuable in resource-limited settings and community rehabilitation programs.

**Conclusion:** The results of the case series suggest that OEP after PRP injection may improve pain, balance, functional disability, and fear of fall in patients with knee OA. The combination of pharmacotherapy and targeted rehabilitation appears to provide clinically beneficial outcomes and may represent an effective integrative management approach to knee OA.

**Limitation:** Despite these promising results, the variability in PRP dosage and the number of injections among participants may have influenced treatment response. Also, Grade 2 and 3 Knee OA cases were assessed in case series. Future studies with a randomised control trial study design and a larger sample size, specific to knee OA grades, can be undertaken.

### REFERENCES

1. Lespasio MJ, Piuizzi NS, Husni ME, Muschler GF, Guarino AJ, Mont MA. Knee

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- osteoarthritis: a primer. *The Permanente Journal*. 2017 Sep 13;21:16-83.
2. Adatia A, Rainsford KD, Kean WF. Osteoarthritis of the knee and hip. Part I: aetiology and pathogenesis as a basis for pharmacotherapy. *Journal of pharmacy and pharmacology*. 2012 May;64(5):617-25.
  3. Anzillotti G, Conte P, Di Matteo B, Bertolino EM, Marcacci M, Kon E. Injection of biologic agents for treating severe knee osteoarthritis: is there a chance for a good outcome? A systematic review of clinical evidence. *European Review for Medical & Pharmacological Sciences*. 2022 Aug 1;26(15).
  4. Glinkowski WM, Tomaszewski W. Intra-articular hyaluronic acid for knee osteoarthritis: a systematic umbrella review. *Journal of Clinical Medicine*. 2025 Feb 14;14(4):1272.
  5. Cakmak O, Coskunsu D, Genc H, Akbaba YA. Effectiveness of exercises performed after platelet-rich plasma in patients with knee osteoarthritis: randomized controlled study. *Medicina Sportiva*. 2021.
  6. Rathi M, Joshi R, Desai R, Gazbare P, Kulkarni N, Kurtkoti A. Effect of OTAGO Exercise Programme on Strength, Balance and Mobility in Elderly: An Experimental Study. *Indian Journal of Physiotherapy & Occupational Therapy*. 2022 Jul 1;16(3).
  7. Davis JC, Hsu CL, Barha C, Jehu DA, Chan P, Ghag C, Jacova P, Adjetej C, Dian L, Parmar N, Madden K. Comparing the cost-effectiveness of the Otago exercise programme among older women and men: a secondary analysis of a randomized controlled trial. *PLoS one*. 2022 Apr 20;17(4):e0267247.
  8. Zhao H, Ou L, Zhang Z, Zhang L, Liu K, Kuang J. The value of deep learning-based X-ray techniques in detecting and classifying KL grades of knee osteoarthritis: a systematic review and meta-analysis. *European Radiology*. 2025 Jan;35(1):327-40.
  9. Divya N, Praveena SP, Saipriyaa M, Meyammai S, Winnie TE, Pavithra R. A Systematic Review on Comparison between Otago Exercise Program and Balance Exercise in Balance and Fall Risk among elderly with Knee Osteoarthritis. *International Journal of Physiotherapy and Research*. 2023;11(5):4628-41.
  10. Alghadir AH, Anwer S, Iqbal ZA, Iqbal A. Test-retest reliability, validity, and minimum detectable change of NPRS in patients with knee osteoarthritis. *BMC Musculoskeletal Disord*. 2018;19:148.
  11. Jogi P, Kumar A, Kumar S. Reliability and validity of Berg Balance Scale in knee osteoarthritis patients. *Indian J Physiother Occup Ther*. 2017;11(1):127-131.
  12. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes in osteoarthritis. *J Rheumatol*. 1988;15(12):1833-1840.
  13. Yardley L, Beyer N, Hauer K, Kempen G, Piot-Ziegler C, Todd C. Development and initial validation of the Falls Efficacy Scale-International (FES-I). *Age Ageing*. 2005;34(6):614-619.
  14. O'Connell B, Wragg NM, Wilson SL. The use of PRP injections in the management of knee osteoarthritis. *Cell and tissue research*. 2019;376(2):143-52.
  15. Kon E, Buda R, Filardo G, Di Martino A, Timoncini A, Cenacchi A, Fornasari PM, Giannini S, Marcacci M. Platelet-rich plasma: intra-articular knee injections produced favorable results on degenerative cartilage lesions. *Knee Surgery, Sports Traumatology, Arthroscopy*. 2010;18(4):472-9.
  16. Migliorini F, Schäfer L, Pilone M, Bell A, Simeone F, Maffulli N. Similar efficacy of intra-articular hyaluronic acid injections and other biologically active injections in patients with early stages knee osteoarthritis: a level I meta-analysis. *Archives of orthopaedic and trauma surgery*. 2024;145(1):68.
  17. Raposo F, Ramos M, Lúcia Cruz A. Effects of exercise on knee osteoarthritis: A systematic review. *Musculoskeletal care*. 2021;19(4):399-435.
  18. Bennell KL, Egerton T, Wrigley TV, Hodges PW, Hunt M, Roos EM, Kyriakides M, Metcalf B, Forbes A, Ageberg E, Hinman RS. Comparison of neuromuscular and quadriceps strengthening exercise in the treatment of varus malaligned knees with medial knee osteoarthritis: a randomised controlled trial protocol. *BMC musculoskeletal disorders*. 2011;12(1):276.
  19. Yang Y, Wang K, Liu H, Qu J, Wang Y, Chen P, Zhang T, Luo J. The impact of Otago exercise programme on the prevention of falls in older adult: a systematic review. *Frontiers in public health*. 2022;10:953593.
  20. Xie C, Wang W, Pei J, Wang H, Lv H. Effect of otago exercise on falls in patients with osteoarthritis: a protocol for systematic review and meta-analysis. *Medicine*. 2020 11;99(50):e23559.
  21. Mat S, Ng CT, Tan MP. Effect of the Otago exercises on postural balance and fear of falling

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- among older fallers with knee osteoarthritis. *Osteoarthritis and Cartilage*. 2016;24:S66.
22. Andia I, Maffulli N. Platelet-rich plasma for managing pain and inflammation in osteoarthritis. *Nature Reviews Rheumatology*. 2013;9(12):721-30.
  23. Çitozi R, Xhebexhiu K, Geantă VA. Effects of the Otago Exercise Program on Balance Among Nursing Home Residents: A 12-Week Quasi-Experimental Study. *Sport Mont*. 2025 ;23(2):71-7.
  24. Cakmak et al., investigated exercises performed after PRP injection in knee OA and reported improvements in pain, muscle strength, and function in the PRP + exercise group. 2021